

WHAT IS CLAIMED IS:

1. An organic semiconductor device, comprising:
 - a bipolar organic semiconductor layer in which electrons and holes are movable;
 - a hole giving/receiving electrode for giving/receiving holes to/from the organic semiconductor layer;
 - an electron giving/receiving electrode, spaced a predetermined distance from the hole giving/receiving electrode, for giving/receiving electrons to/from the organic semiconductor layer;
 - a hole-side gate electrode, arranged opposing to a region of the organic semiconductor layer near the hole giving/receiving electrode with an insulating layer sandwiched, for controlling distribution of holes in the organic semiconductor layer; and
 - an electron-side gate electrode, arranged opposing to a region of the organic semiconductor layer near the electron giving/receiving electrode with an insulating layer sandwiched, for controlling distribution of electrons in the organic semiconductor layer.
2. The organic semiconductor device according to Claim 1, wherein the organic semiconductor layer is formed of a bipolar organic semiconductor material.

3. The organic semiconductor device according to Claim 1, wherein the organic semiconductor layer includes a laminated structural film with an N-type organic semiconductor layer and a P-type organic semiconductor layer laminated with each other.

4. The organic semiconductor device according to Claim 1, wherein the organic semiconductor layer has a junction film structure including an N-type organic semiconductor layer and a P-type organic semiconductor layer having a junction portion between the hole giving/receiving electrode layer and the electron giving/receiving electrode layer.

5. The organic semiconductor device according to Claim 1, wherein the organic semiconductor layer is formed of a mixture of an N-type organic semiconductor material and a P-type organic semiconductor material.

6. The organic semiconductor device according to any one of Claims 1 through 5, wherein the hole giving/receiving electrode is an hole injecting electrode for injecting holes into the organic semiconductor layer, and the electron giving/receiving electrode is an electron injecting electrode for injecting electrons into the organic semiconductor layer.

7. The organic semiconductor device according to Claim 6,

wherein the organic semiconductor layer is an organic semiconductor light emitting layer that emits light by recombination of holes and electrons in the layer.

8. The organic semiconductor device according to Claim 6 or 7, further comprising a control circuit that independently applies control voltages to the hole-side gate electrode and the electron-side gate electrode.

9. A display comprising a plurality of the organic semiconductor devices according to any one of Claims 6 through 8 arranged on a substrate.

10. The organic semiconductor device according to any one of Claims 1 through 5, wherein the organic semiconductor layer is an organic semiconductor photo-sensitive layer that generates pairs of electrons and holes through external irradiation of light.

11. An imager comprising a plurality of the organic semiconductor devices according to Claim 10 arranged on a substrate.